MonPS18

Determination of Energy and Angular Distribution Functions of the Surface-Produced Negative Ions in H_2/D_2 Plasmas by Mass Spectrometry

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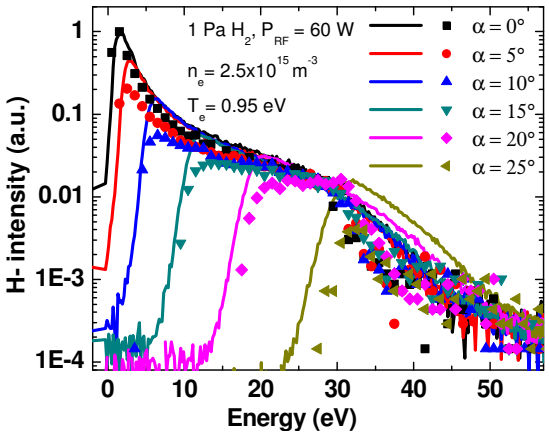
This work focuses on understanding of the negative-ion (NI) production mechanism on surfaces in low pressure H_2/D_2 plasmas. The aim is to enable the development of cesium-free NI sources, which would be valuable for many applications, particularly for neutral beam injectors of future nuclear fusion reactors. H^-/D^- are produced on the surface of HOPG (Highly Oriented Pyrolitic Graphite) and Gd (low work function metal) negatively biased in the plasma. Some of the positive ions attracted by the sample capture electrons at the surface and produce NI which are self-extracted and detected by mass spectrometry according to their energy. The shape of the measured NI energy distribution functions (NIEDFs) depends both on the surface production mechanism and on the ion transport in the plasma and in the mass spectrometer. A model has been developed previously [1,2] in which NIEDFs are computed using SRIM calculation for the hydrogen particles created on the surface upon positive-ion bombardment. This output is further convoluted with the ion transmission function between the sample and the mass spectrometer. Here we present an improved model which takes into account the sample tilt with respect to the mass spectrometer (see figure). Based on this model, we propose a reconstruction method of the experimental energy and angular distribution functions of the NI created at the sample surface. The algorithm is purely geometrical and does not depend on the NI surface production mechanism, so it can be applied to any type of material or NI.



References

[1] G. Cartry et al. 2012 *Phys. Plasmas* 19 pp 063503
[2] A. Ahmad et al. 2013 *Plasma Sources Sci. Technol.* 22 pp 025006